included in the halogenated oil, the concentration needs to be limited to such a low degree that it is present only on the particle surface. A chain structure formed by the electric field is necessarily accompanied with the exhibition of the electroheleogical phenomenon, and the shape and thickness of the chain depend on the physical and chemical properties of the components of the fluid. The performance and stability of electroheleogical fluids developed up to now are difficult to meet a stress transfer property required in practical devices, and these fluids thus need to be improved in their performance and stability. Yield stress, a representative property, depends on the applied electric field strength and the particle volume fraction. To achieve a greater yield stress at a realizable electric field strength, increases the particle volume fraction and is effective. However, this particle volume fraction cannot disadvantageously exceed any maximum value, which is varied depending on a viscosity of the dispersion medium, and a shape and surface property of the particles. Moreover, an excessively concentrated dispersion system is excessively high in its viscosity in the absence of the electric field, as well as in the electric current leakage that causes the dielectric breakdown on the application of the large electric field. For this reason, this dispersion system is disadvantageous in that it has insufficient controllability and stability. Thus, a new electroheleogical fluid is required that is not excessively high in its particle concentration while having a high yield stress and an excellent stability.

[0010] In addition to the particles suspended in the insulating dispersion medium, an emulsion liquid droplet also undergoes an electrostatic interaction in the presence of the electric field. An article by Pan et al. has reported electroheleogical properties of an emulsion under the electric field (Pan et al., "Characteristics of Electroheleogical Response in an Emulsion System", J. Colloidal and Interface Science, Vol. 195, No. 1, 1997, pp. 101-113). U.S. Pat. No. 6,645,403 to Park et al entitled, "Multiphase Electroheleogical Fluid" and incorporated by reference herein.

[0011] However, consideration of electrically active fluidic materials may also be applied in situations where the change in viscosity may create unusual configurations if harnessed properly. Thus, materials whether electro-heleological or film or sputtered metal foils, or another kind of material that responds to an electrical current or magnetic field and changes configurations either atomically or metalurgically, may find use in devices that could take advantage of the reconfigured material.

[0012] The use of expansive and current attractive materials that respond to electrical pulses allows for particular enhancements in tactile-based computational devices. The present invention contemplates several different types or applications of the various materials that change shape, structure, viscosity or other properties based on electrical pulses or currents.

SUMMARY OF THE INVENTION

[0013] The present invention contemplates a comprehensive tactile-based operational and display system for vision impaired users using the expansive and contractive materials in a layer between an electrically conductive sheet and either a finger or other type of circuit completion. The electrical circuit completion by way of the finger or another conductive sheet allows the display to tactically reconfigure through the expansion and contraction of the materials based on electrical signals. Thus, one may think of a "tactile pixel" or tixel™ in which a small portion of a display screen is either raised or lowered or made convex or concave based on specific operations. While in a most complex embodiment, the invention involves a comprehensive input and output system for vision impaired use implementing finger based, or tap and drop computing. There are other applications which are anticipated to be useful within the scope of this invention in areas as diverse as consumer electronics, industrial controls, and manufacturing environments in which display screens may be enhanced with simple tactile-based finger locations to improve performance and reduce operator error.

[0014] The particular advantage of the present invention over a simple, permanent and/or not dynamic tactically-enhanced screen such as a cell phone or an industrial control panel is that the present invention teaches a reconfigurable tactile display that is anticipated to act as an input screen as well.

[0015] The prior art, which involves touch screens and digitized input screens, is not sufficient to enhance the tactile-based accuracy for the alternative embodiment of the invention. For example, in an industrial setting, a LCD control panel is required for the operation of heavy industrial equipment. The results of pushing the incorrect button may be severe, so the program is executed on the screen such to give the operator a second chance if there is some error which is anticipated. However, this involves extra code and is not necessarily mutually exclusive with the present invention, which simply enhances the screen such that it may be reconfigured each time it is used such that a raised portion maybe in the form of a rectangle or a circle which allows the user to press the right area on the input screen.

[0016] The industrial control panel of the display acts as both input and output and is a simple application of the reconfigurable tactile portion of the screen. However, it is not necessary to have a critical manufacturing setting to take advantage of using a tactile-based guide for fingers to find the proper location. For example, in an automotive use, an LCD or LED input screen is utilized by a user in order to set the temperature or program an aspect of an automobile whereby the user would have a tactile enhancement such that while driving they would not be distracted by looking down at the input screen but rather could feel it with their fingers and press on the appropriate spot. One could see that the automotive audio system would be ideal for this particular situation because a driver would not have to look down to make sure they're pressing the correct button or location but, in fact, would rather be able to feel along the tactile enhanced panel and pick the appropriate button. Although, it is anticipated that the simple automotive and industrial use without reconfiguration is not part of the invention, the importance of being able to reconfigure the tactile portion of the screen is critical as it is not necessary to program the same number of selections every time. Thus, the prior art includes a screen with purely static tactile features in which a clear film or plastic may be put over a display screen, but in no way could this screen be reconfigured such that there are six buttons instead of four. Thus the prior art includes a screen with a tactile feature whereas an embodiment of the present invention extends this concept to make the screen reconfigurable. However, the primary